



Clean Water through Protection and Partnership

# NYC Watershed Science Technical Conference & Exhibition



September 13, 2016

Diamond Mills Hotel, Saugerties, NY





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## INTRODUCTION AND ACKNOWLEDGMENTS

Dear Conference Participants,

In 1997, the signatories to the historic New York City Watershed Agreement formed an enduring partnership to protect and enhance the City's Watershed and the scores of communities living within it. Underlying this complex social and political undertaking has been an unprecedented technical initiative among scores of local, State and Federal agencies with one common goal: to advance the science of watershed protection.

The Watershed Science and Technical Conference was created as an annual opportunity to bring scientists, professionals, and other experts together with watershed stakeholders and the public, to technically inform, exchange ideas, and unveil new information regarding the protection of the nation's largest unfiltered surface water supply.

Each year, this conference showcases the most current trends, technologies and scientific developments in the arena of watershed protection and management. The conference continues to punctuate the multiple longstanding themes that remain central to the business of caring for a watershed:

- Stormwater control,
- Wastewater treatment,
- Stream health,
- Emerging contaminants and microconstituents,
- Monitoring and modeling,
- Pathogens, nutrients, and turbidity,
- Recreational use, forestry, agriculture, and more.

The Conference Call for Abstracts was made to agencies and stakeholders in and beyond the New York City Watershed. The resulting responses were reviewed by the Technical Program Committee for technical merit and interdisciplinary utility, as well as temporal and substantive relevance. Those chosen by the Committee for presentation at this year's Conference are included in this Compendium.

In addition to our esteemed presenters and all those who submitted their scientific endeavors, we wish to thank the many agencies, professional organizations, and individuals who contributed to the success of this conference. It is our hope that all who attend will be edified by the scientific data presented, and inspired by the dedication and hard work of those who, each day, advance our insight into the science of protecting the drinking water for nine million New Yorkers.

Respectfully,

Lisa Melville  
NYC Watershed Programs Coordinator  
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For the Conference Organizers and Sponsors:

The Watershed Protection and Partnership Council  
The New York Water Environment Association, Inc.  
The New York State Department of State  
The New York State Department of Environmental Conservation  
The New York State Department of Health  
The New York City Department of Environmental Protection  
The Catskill Watershed Corporation  
The Watershed Agricultural Council  
The United States Geological Survey  
The New York State Environmental Facilities Corporation

## **Application of Microbial Source Tracking Techniques in Response to the Detection of Increased Indicator Organisms in a Watershed Stream**

*Kerri Alderisio, NYC Department of Environmental Protection*

The New York City Department of Environmental Protection (NYC DEP) routinely monitors the water quality of streams, reservoirs and aqueducts in the watershed for indicator organisms. Fecal coliform bacteria in particular are used as indicators of fecal pollution, and by association, indicate the potential presence of more resilient microbes. Ultimately, with the mission of providing drinking water of the highest quality, it is a goal of the Department to identify the source of these organisms and implement management practices that will eliminate the source. Microbial Source Tracking (MST) is a way to help identify sources of microbes, and there are many approaches and techniques available. Most recently, NYC DEP has used the analysis of Bacteroidales and Cryptosporidium genotyping through the use of polymerase chain reaction (PCR) to assist in the identification of microbial sources. For example, in 2015, a stream sample in the Kensico Reservoir watershed resulted in a Cryptosporidium concentration that received attention as it exceeded the 95th percentile of the previous 10 years of data. New collection sites upstream were established to determine the breadth of occurrence in the stream course. Samples were collected and analyzed for fecal coliforms, turbidity and protozoa (Giardia and Cryptosporidium) and a sanitary survey walk through of the area was performed. This presentation will review the follow up monitoring and discuss the routine water quality and MST results as they pertain to identifying the source(s) of the occurrence.

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## **Addressing Low Matrix Spike Recoveries for Cryptosporidium and Giardia in Finished Water**

*Kirsten Askildsen, Lisa McDonald, William Kuhne, NYC Department of Environmental Protection*

While researching the ability to increase the volume of sample filtered for Cryptosporidium and Giardia analysis at DEP's Hillview Reservoir, seasonal low Matrix Spike (MS) recoveries were observed for Giardia with EPA Method 1623. Hillview Reservoir water has a unique matrix compared to other sites that are analyzed by DEP in that this is the only site that has been treated with chemicals including chlorine, sodium hydroxide, fluoride, and orthophosphate as part of the finishing process to protect public health and provide corrosion control in the

distribution system. During routine monitoring, the laboratory experienced intermittently low MS recoveries for Cryptosporidium and Giardia, with some recoveries as low as 0 percent.

To address the low recoveries, the DEP Pathogen Laboratory investigated various method modifications to see if the matrix spike recoveries could be improved at this location, and troubleshooting the method ultimately lead to two major improvements. First, the addition of sodium hexametaphosphate, incorporated in a switch from method EPA 1623 to EPA 1623.1, improved the recovery for Cryptosporidium oocysts. Second, using heat, instead of acid, in the dissociation step of the analysis improved the recovery of Giardia cysts. Implementing these changes in conjunction resulted in improved recovery for both pathogens in the Hillview Reservoir matrix. In this study, mean MS recovery for Cryptosporidium improved from 28 percent to 57 percent, while Giardia MS recovery rose from 36 percent to 57 percent. These method changes may help recovery at other sites if challenging matrices are encountered.

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## **Life Cycle Cost Evaluation of Alternative Wastewater Collection Systems for Small Communities**

*Julie Barown, Orenco Systems, Inc.*

When the term "Sewer" is used today, what is generally meant is conventional gravity sewer. While this technology has served humans well for thousands of years, and continues to do so today, there are many instances where newer technologies can serve communities in a more cost effective manner. In many instances these "alternative" technologies are the best, most cost effective way to provide a service that helps to protect human health and the environment. They have been serving communities for decades, and can provide a truly sustainable solution in areas where the "conventional wisdom" simply won't work.

Design engineers shy away from "alternative" sewer collection technologies due to the perception that they are more expensive to operate and maintain than gravity sewers. Operational data from long-term pressure sewer systems hasn't been readily available, due to the variety of data, variability in equipment quality, variability in operational and management procedures, and a simple lack of documentation. Today, enough data is available to accurately summarize alternative sewer costs associated with proactive maintenance, reactive maintenance, equipment repair and replacement, and solids management.

This presentation introduces two alternative methods for providing sewer service, comparing and contrasting them with conventional gravity sewer. First, gravity sewer is discussed, with some of the basic design aspects presented, advantages and disadvantages, the equipment that is used, and some basic cost numbers for some rural, small communities. The “alternative” technologies will then be discussed, with the same basic format. Life-cycle costs of alternative technologies will then be discussed at length with information provided by the Water Environment Research Foundation (WERF) and then validated with a real world cost estimating example, summarizing the operation and maintenance of each alternative technology. Grinder Sewers and Effluent Sewers are the two sewerage technologies that will be compared to conventional gravity sewer.

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### **Coordinating With Local Municipalities on Floodplain Management and Mitigation in the NYC Watershed**

*Aaron Bennett, Ulster County Department of Environment*

Over the last 60 years, Ulster County ranks second for the most flooding-related disaster declarations in NY. Through a recent partnership with the Ashokan Watershed Stream Management Program, the County is able to provide several of its smallest, remote, and flood-vulnerable municipalities with technical assistance, planning/coordination, grant-writing, and other previously un-met needs in the name of flood hazard mitigation. This presentation will highlight recent work in five small towns, as well as at the County level, in the NYC Watershed. An abundance of flood hazard mitigation projects have been identified by the communities, have been inter-related as needed, and are now on the path toward implementation. Participants will learn the techniques used, lessons learned and challenges faced when working with communities that lack the capacity (time, resources, training, and skills) needed to navigate the path from mitigation planning to preparing grant applications in order to bring the best mitigation projects to fruition.

By working side-by-side with local municipal officials, a robust, detailed, and thorough mitigation strategy has been captured in the recent update to the Ulster County Multi-Jurisdictional All-Hazard Mitigation Plan (2016). Several of these strategies have also been included within recent flood studies and local planning efforts, including the New York Community Reconstruction Program, Local Flood Analyses (in several population centers), stream management plans, and even town wide flood hazard mitigation plans.

Within the last two years, guidance at both the Federal (Federal Flood Risk Management Standard) and State

(Community Risk and Resiliency Act) level have directed respective agency staff to incorporate more forward-thinking mitigation measures that will consider climate change impacts into future program guidelines. To address these changes, to provide for local communities to take advantage of the funding opportunities that result, the work conducted by the County and its partners is crucial so the leaders of these small communities can take action on the potential solutions that will reduce the flood risks in the future.

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### **Increased Salinity and Nutrient Effects on Phytoplankton in a Suburban Lake**

*Steve Di Lonardo, Kam Truhn, John D. Wehr, Fordham University; Emily P. Pinckney, Humboldt State University*

Cyanobacteria blooms are an increasingly significant environmental and public health issue occurring in water bodies with elevated nutrients, low turbulence, and warm temperatures. Studies suggest that increased salinity (from road salt) may enhance these blooms. We studied the effects of nutrients and sodium chloride on algal production and nutrient uptake in North Lake, a suburban lake in Westchester County, NY. North Lake has recently experienced significant increases in conductivity (total salts) and chloride. In-situ experiments aiming to double ambient nitrogen, phosphorus and sodium chloride levels were conducted in 1-L plastic containers using a 2 x 2 x 2 factorial design (Nitrogen x Phosphorus x Sodium Chloride; n = 3) over a four-day period in mid-summer when the phytoplankton assemblage was composed of diatoms and green algae (15 percent cyanobacteria) and early autumn, then composed of diatoms and blue-green algae (30 percent cyanobacteria). Results of the mid-summer experiment indicated that algal production was significantly enhanced by phosphorus, but not nitrogen, and inhibited by sodium chloride. Rates of nitrogen and phosphorus nutrient uptake were unaffected by sodium chloride treatment, but final algal nitrogen content in nitrogen-amended microcosms was greater in sodium chloride treatments. The early autumn experiment with a greater percentage of cyanobacteria indicated that algal production was stimulated by nitrogen and especially by nitrogen + phosphorus, but not by phosphorus or sodium chloride. Final algal nitrogen content in all but the control microcosms was greater in sodium chloride treatments. Results from the mid-summer experiment indicated that diatoms and green algae were inhibited by elevated salinity but no effect of sodium chloride was observed when the assemblage had a greater percentage of nitrogen-fixing cyanobacteria, suggesting that cyanobacteria blooms in this system may not be enhanced

by sodium chloride. Further studies are planned on cyanobacteria-dominant (> 50 percent) assemblages to clarify these findings.

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## **Development of High-Resolution Bathymetry for Six West of Hudson Reservoirs: Implications for Water Quality Management**

*Jordan Gass, NYC Department of Environmental Protection; Elizabeth Nystrom, United States Geologic Survey*

The New York City Department of Environmental Protection (DEP) utilizes simulation models to inform management decisions for reservoir operations and water quality management. These models require a variety of accurate input data, including reservoir bathymetry, to generate reliable predictions. Comprehensive bathymetric surveys of the six West of Hudson (WOH) reservoirs were last completed in 1997. Since that time, processes such as sedimentation, erosion and watershed management may have changed the overall morphology of the reservoirs. These processes necessitate updated bathymetry to support current modeling activities, produced at a higher resolution available with current technology.

In 2013, DEP contracted with the United States Geologic Service to survey the six WOH reservoirs to generate a high resolution bathymetry dataset for use in water quality and operations modeling. This project will improve DEP's knowledge of the reservoirs by using more accurate methods and technology than were available during previous surveys. This presentation will focus on the newly collected reservoir data, including comparisons with the dataset currently in use. The bathymetric data will be reviewed for any spatial patterns that may help to explain changes, and thereby inform future management scenarios. It will describe how the storage capacity estimates for each reservoir have changed, and discuss some of the possible reasons for these changes.

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## **Development and Testing of a Probabilistic Turbidity Model for Rondout Reservoir**

*Rakesh Gelda, NYC Department of Environmental Protection*

New York City Department of Environmental Protection (NYCDEP) now routinely uses the Operations Support Tool (OST) software to help guide reservoir operating decisions involving both the quantity and quality of water. An important water quality parameter of concern for the City's water supply is turbidity. Here we develop a tool to forecast more realistic simulations of turbidity in Rondout Reservoir withdrawal. This can then be specified as input to the Kensico Reservoir turbidity model in OST, thus making the forecasts of turbidity in the Kensico Reservoir withdrawal more accurate. The proposed modeling tool is based on a separate turbidity model for Rondout Reservoir, which was developed and validated earlier. With the added capability of using short-term ensemble forecasts of hydrological inputs, turbidity, and climatology as the model drivers, it can generate probabilistic forecasts of turbidity. The tool is expected to help guide operations of Rondout Reservoir during storm events in the watershed as well as provide realistic estimates of turbidity inputs for the Kensico Reservoir model in OST.

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## **Realistically Predicting Saturation Excess Runoff with SWAT-Hillslope**

*Linh Hoang, Ph.D., City University of New York; Elliot M. Schneiderman, Karen E. Moore, Ph.D., NYC Department of Environmental Protection; Tammo S. Steenhuis, Cornell University*

Saturation excess runoff is without doubt the major runoff mechanism in the humid well- vegetated areas where infiltration rates often exceed the medium rainfall intensity. Despite its preponderance, incorporating this runoff in distributed models has been slow and fraught with difficulties. The Soil and Water Assessment Tool (SWAT) uses information of soil plant characteristics and hydrologic conditions to predict runoff and thus is implicitly based on infiltration-excess runoff. Previous attempts to incorporate the saturation excess runoff mechanism in SWAT fell short because of the inability to distribute water from one Hydrological Response Unit (HRU) to another. This study introduces a modified version of SWAT, referred as SWAT-Hillslope. It improves the simulation of saturation excess runoff by redefining HRUs to include landscape position, grouping the newly defined HRUs into wetness classes and by introducing a perched water table with the ability to route

interflow from “drier” to “wetter” HRUs. Mathematically, the perched aquifer is a non-linear reservoir that generates rapid subsurface stormflow as the perched water table rises. The SWAT-Hillslope model was tested in the Town Brook watershed in the upper reaches of the West Branch of the Delaware in the Catskill Mountains. The results showed that SWAT-Hillslope could predict discharge well with Nash-Sutcliffe Efficiency of 0.68 and 0.87 for daily and monthly time steps. Compared to the original SWAT model, SWAT-Hillslope predicted less surface runoff and groundwater flow and more lateral flow. The saturated areas in SWAT-Hillslope were concentrated in locations with high topographic index and was in agreement with field observations. With the incorporation of topography characteristics and the addition of the perched aquifer, SWAT-Hillslope gives a realistic representation of hydrological processes and will lead to better water quality models where the source of the surface runoff matters.

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## Storm Water Screening and Management

*James Impero, Ovivo*

Growth and advancement of society populations have created vast areas of concrete asphalt construction and expansion. This has produced vast runoff of water that calls for proper storm water management to protect vital resources. What once was absorbed by and across vegetation, marshes or forest floors and into our earth to replenish ground water, streams, rivers, lakes and oceans now compromises pavement roadways and infra-structure preventing the storm water from properly replenishing the earth and its natural recycling system.

Proper deployment of holding ponds and/or drainage ditches to receive vast quantities of storm water requires systems & equipment to be installed to remove human debris, live and dead vegetation, branches, and sediments from impeding flow. Clogged drainage systems and/or inlet openings to large waterways cause storm water to back up and flood upstream. Low lying areas often flood not only causing land erosion, but damage to area roads, homes and businesses.

The trend today in storm water management is to remove most if not all flushed man made materials and objects, as well as debris from living and dead matter. The primary reason is to curb the flow of debris washed into our waterways from streets, highways, and bayous leading to our rivers, lakes and reservoirs. This debris not only causes flooding due to sediment and trash accumulation, but increases turbidity in our waterways from stirred sediment, habitat destruction, erosion and sewer over flow.

This paper will discuss low operator attendance screening methods for keeping debris from clogging surface drainage

ditches, holding ponds, large concrete pipe, as well as deep tunnel collection and pumping systems.

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## Monitoring of DBPs in Select NYC Water Supply Reservoirs through the Deployment and Operation of Automated Monitoring Buoys

*Emily Kinne, Lori Froehlich, Paul Brown, Ph.D., Chris Morgans, Kim Nezelek, Sara Storrer, Michael Jadlicky, NYC Department of Environmental Protection*

The NYC Water Supply is required to meet the SDWA Stage II Disinfection Byproduct (DBP) rule for levels of DBPs in the drinking water distribution system. To ensure continued compliance with this rule, the Bureau of Water Supply (BWS) has begun an increased monitoring effort in its water supply reservoirs for DBP precursors. During drinking water disinfection, naturally occurring organic compounds are converted to DBPs. This increased monitoring effort is therefore focused on measuring in-reservoir carbon forms. These data will be used to improve reservoir eutrophication models which will provide a better understanding of the cycling of organic carbon in water supply reservoirs. Such modeling improvements will enable the BWS to better operate the water supply to reduce the potential for DBP formation.

To meet the need for high frequency in-reservoir data measurements for model development the BWS began deployment of enhanced automated monitoring buoys on Cannonsville and Neversink reservoirs in 2015. These enhanced buoys are equipped with optical probe technology which measures dissolved organic matter, chlorophyll a, blue-green algae and dissolved oxygen in situ. This presentation will discuss the development of this new monitoring program including the validation and calibration of the optical probes; the deployment and continued operation of the automated monitoring buoys; the automated data retrieval and management system; and a brief comparison of optical measurements to laboratory results.

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## **Pilot Evaluation of Object Based Image Analysis Leveraging High Resolution Orthoimagery and LiDAR Derivatives to Improve the Accuracy and Completeness of Wetland Mapping and Connectivity Assessment in the New York City Water Supply Watershed**

*Laurie Machung, NYC Department of Environmental Protection*

In 2009, DEP's Bureau of Water Supply GIS program acquired LiDAR point data and high resolution orthoimagery for the New York City Watershed from which high resolution hydrography, topography and landuse/landcover data layers were derived. In 2015, DEP completed a pilot project to assess the applicability of these high resolution LiDAR-derived databases towards improved National Wetlands Inventory (NWI) mapping and assessment of wetland connectivity to downstream waters. Incorporation of LiDAR-derived data into an Object Based Image Analysis Protocol more than doubled the acreage of vegetated wetlands mapped in the Catskill/Delaware watersheds. In addition, availability of local resolution (1:1,000) LiDAR-derived National Hydrography data (NHD) improved our ability to assess wetland connectivity to downstream waters. The percentage of NWI wetlands determined to be unconnected to downstream waters was reduced from 35 percent to 2 percent by using local rather than medium (1:100,000) resolution NHD. Improved mapping of wetland and aquatic resources provides base data to support watershed protection through DEP's forest management, agricultural, land acquisition, regulatory, and numerous other programs. As of December 2015, DEP's land acquisition program has protected over 2800 acres of these mapped wetlands and the ecosystem services they provide.

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## **Water Quality Status and Trends in the New York City Water Supply's Catskill/Delaware System**

*James Mayfield, Karen Moore, Ph.D., Richard Van Dreason, David Van Valkenburg, NYC Department of Environmental Protection*

The New York State Department of Health's (NYSDOH) May 2014 Filtration Avoidance Determination (FAD) for the Catskill/Delaware Water Supply Systems requires DEP to undertake a comprehensive evaluation of the watershed programs every five years. In March 2016, DEP completed the latest Summary and Assessment Report, which included an examination of watershed water quality status and trends

to demonstrate the effectiveness of the watershed programs. A three year time period (2012-2014) was used to assess water quality status because the time period has to be sufficiently short so that any trends are minimized, but sufficiently long to minimize short-term fluctuations. In addition to assessing status, water quality trends for key analytes, such as turbidity, fecal coliforms, total phosphorus (TP), Trophic State Index (TSI), and specific conductivity are presented from 1993-2014. Long-term water quality data such as this are needed to show the effects of the watershed protection programs because there may be time lags between program implementation and water quality changes. The long-term record also provides a view of water quality changes in the context of variation caused by natural events such as floods and droughts. Also, biomonitoring samples were collected to assist in assessing stream conditions because macroinvertebrates biologically integrate conditions over time and can be seen as important indicators of stream water quality. Finally, an analysis of pathogen transport through the system will provide insight into the benefit of NYC's sequential system of reservoirs and the natural processes that improve water quality as it travels towards distribution. Overall the results show that despite the confounding effects of large storms like Irene and Lee downward trends were detected for key analytes which provide evidence of the success of the watershed programs in improving and protecting the water supply for over nine million consumers.

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## **Deciphering the Climate Signal and Other Sources of Change in Stream Water Quality**

*Karen Moore, Ph.D., NYC Department of Environmental Protection; Kyongho Son, Ph.D., Hunter College, City University of New York*

Climate projections for New York City's water supply watersheds generally indicate that increases in temperature, precipitation, and potential evapotranspiration, with consequent reductions in snowpack and changes in the timing of runoff, are anticipated. These changes have important implications for impacts on the nitrogen cycle, with potential increases in the release of nitrate to surface waters. Murdoch et al. (1998) used a novel approach to examine the long-term effects of temperature on nitrate leaching from Biscuit Brook, a headwater stream in the Catskill region, and showed that mineralization and nitrification, rather than deposition or vegetation uptake, were the primary factors controlling nitrogen leaching from the watershed for the period of 1983-1995. We revisited their approach for later years at the same site and expand our inquiry to other sites in the region to investigate trends

in nitrate concentration over a 20+ year period of record. We used a variety of approaches to look at trends in annual, seasonal, and event-based nitrate concentration, and the relationship between trends in nitrate concentration and different flow conditions. We also explored the patterns in dissolved organic carbon and look at the interrelationships between nitrate and other water quality indicators. We expect that using long-term records of water quality in this study will allow us to have a better understanding of changes in stream water quality with respect to climate change.

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### **Mass Balance Modeling and Laboratory Experiments to Evaluate Autochthonous Production/Loss of Trihalomethane Precursors**

*Emmet Owens, NYC Department of Environmental Protection*

EPA's Stage 2 Disinfectants/Disinfection Byproducts rule places restrictions on trihalomethanes (THMs) and haloacetic acids (HAAs) in drinking water. In order to comply with these federal regulations, and to more generally understand the behavior of the precursors to these disinfection byproducts (DBPs), NYCDEP is developing models that are capable of predicting the sources, transport, and fate of DBP precursors in the watersheds and reservoirs that make up the water supply. A monitoring program for THM precursors and dissolved organic carbon (DOC) was conducted on six West of Hudson reservoirs in 1997-98. This program involved weekly sampling and analysis over the full reservoir depth at a single site, at the mouth of the largest stream inflow to each reservoir, and in aqueducts discharging to downstream reservoirs. This monitoring data is presented and analyzed, leading to estimation of external precursor (allochthonous) loading and the net internal (autochthonous) production within each reservoir over the spring to fall period for an individual year. A series of laboratory experiments were conducted to directly measure the rate of various processes that produce and deplete organic carbon and THM precursors in the reservoir water column, including carbon fixation and excretion in laboratory cultures, THM precursor production, biodegradation, and photolysis. The results of these experiments are summarized. A predictive model for the internal production of THM precursors is presented and evaluated using the field and laboratory data.

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### **Effects of Heavy Rainfall Years on Fecal Coliform and Protozoan Concentrations in Kensico Perennial Streams**

*Christian Pace, Kerri A. Alderisio, NYC Department of Environmental Protection*

Large storm events with heavy rainfall have been well-documented as conditions responsible for mobilization of microbial contaminants. This can be of particular concern for public drinking water supplies where water authorities must meet regulatory standards to protect public health. Kensico Reservoir, in the New York City Watershed, is the terminal reservoir for the Catskill and Delaware Systems. In addition to receiving water from West of Hudson reservoirs, Kensico has its own small watershed including eight perennial streams, some of which are proximal to water intake structures. As potential sources of contamination, efforts have been made to improve stream water quality including various best management practices and several water quality studies have been conducted.

In 2011, over 73 inches of precipitation were recorded in the Kensico watershed area, the second highest annual total since 1949. More acutely, several large storms (>1.5 inches day<sup>-1</sup>) in the spring and late summer impacted the Kensico and upstate watersheds. Following these storms, several elevated fecal coliform results at the Kensico output sites caused DEP to modify its watershed operations in order to remain within regulatory requirements. From 2012 to 2015, with below average rainfall, and a below average number of heavy rainfall events, there was only one instance of a fecal coliform result over 20 fecal coliform 100mL<sup>-1</sup>. These observations suggest "wetter" years are associated with higher microbial concentrations at the reservoir output.

In this presentation, microbial results (fecal coliform bacteria, Giardia, and Cryptosporidium) from sampling at the eight Kensico perennial tributaries and aqueduct keypoints will be assessed to determine the effect of wet versus dry years, and years with a higher prevalence of large storms. Seasonal trends on microbial levels and potential impacts on transport of microbes will be investigated.

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### **Investigating Non-Synthetic Chemical Alternatives to Glyphosate along NYC Roadways Within the NYC Watershed System**

*David Quentin, Kerri Alderisio, John Vickers, P.E., NYC Department of Environmental Protection*

It is important to limit vegetation growth adjacent to roads to ensure the safety of the traveling public. Vegetation

control under guidrails is very difficult to efficiently perform by mechanical means. DEP maintains close to 100 miles of NYC owned public roads and has used EPA and state approved herbicides to control vegetation under the guidrails along those roads.

Recent observations of poorly placed herbicide applications by others assisting DEP with the maintenance of NYC watershed roadways prompted DEP to investigate other avenues of managing weed growth. Glyphosate, the active ingredient in the herbicide used, was a cause of concern for DEP and watershed citizenry due to its environmental and human health risk potential. Research was conducted to discover a non-synthetic, safer alternative to glyphosate with the goal being cost effective to use, a negligible risk potential, and effective during the entire plant growing season.

Two products were chosen for this study: Finale and Burnout II. Finale, with the active ingredient of glufosinate ammonium, is derived from two species of Streptomyces. Burnout II is derived from ascorbic acid and clove oil.

Two sites were chosen along Route 28A within the Ashokan Reservoir watershed: the Ashokan Campus and the intersection of Shokan Heights Road and Whispell Hollow Road. These two sites have different environmental characteristics and represent an ample comparison of the efficacy of the two herbicides. An initial site visit was conducted, then at determined times after herbicide applications to note the effectiveness, represented by percent eradication. The last site visit was approximately three months after the herbicide application.

Results showed Finale eradicated most of the vegetation at both sites with regrowth noted at the end of the observation period. Burnout II was ineffective throughout the entire study. It was determined that Finale was the best choice to replace glyphosate.

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## **NYC Wastewater Upgrade Program an Environmental Success PLUS**

*Robert Ravallo, NYC Department of Environmental Protection*

As part of the MOA, the City agreed to fund the eligible costs of designing, permitting and constructing upgrades of all non-City-owned wastewater treatment plants (WWTPs) in the watershed. For the purposes of this program, "Upgrades" mean equipment and methods of operation that are required solely by the Watershed Rules & Regulations (WR&R), and not by federal or State law. The City further agreed to pay the annual costs of operation and maintenance of the upgraded facilities.

The goal of the Program is water quality improvement through implementation of the NYC WR&R.

The presentation will cover the almost 20 year accomplishments of the Program as well significant environmental benefits, economic benefits, new technologies, improved community relations, etc.

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## **NYC's Waterborne Disease Risk Assessment Program: Giardiasis and Cryptosporidiosis Case Rate Trends and Other Updates**

*Anne Seeley, NYC Department of Environmental Protection; Robert Fitzhenry, Sharon Balter, Lisa Alleyne, NYC Department of Health and Mental Hygiene*

NYC's Waterborne Disease Risk Assessment Program (WDRAP) is a public health monitoring program which helps provide assurance of the microbial safety of the City's water supply. WDRAP operates via an inter-agency agreement between the NYC Department of Environmental Protection and the NYC Department of Health and Mental Hygiene. Initially implemented in 1993, numerous program modifications have been implemented based upon enhanced knowledge, data availability shifts, companion program opportunities, and other factors. One major program component of WDRAP is disease surveillance -- involving data collection on the rates, demographics, and potential risk factors, for giardiasis and cryptosporidiosis. Another core program component is syndromic surveillance involving monitoring of indicators of gastrointestinal disease in the community in an effort to detect disease outbreaks before etiologic diagnoses are made. This presentation will provide an update on program components and findings. Included will be an overview of a new clinical laboratory assay which was introduced in 2015 at some NYC hospitals; the impacts of this new assay on the disease case rates will also be presented.

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## **Energy Efficient Design for UV Disinfection Systems**

*David Silverman, PSI Process and Equipment*

As wastewater regulations become increasingly stringent and the effects of energy consumption focus the

water/wastewater industry on climate change, utilities are looking for ways to optimize energy usage at every stage of treatment.

While the need to inactivate chlorine resistant organisms has increased the use of ultraviolet disinfection, it is still both more expensive and has a higher carbon footprint than conventional chlorination. However, many design approaches, equipment configurations and operational practices exist to reduce energy usage while optimizing disinfection.

This presentation will discuss disinfection requirements, process alternatives, and the role of UV in the disinfection matrix. Energy conservation measures such as hybrid disinfection, considering the energy impacts of civil construction, appropriate design and use of controls, and best practices for system maintenance will be considered.

Various configurations of UV will be considered, taking into account holistic energy considerations, including the production of materials used to construct the system, as well as the energy consumed by the system. Efficiencies of various types of UV lamps will be considered. Several types of UV disinfection systems will be reviewed, including closed vessel, open channel, non-contact and chambered systems.

The energy impacts of appropriate control systems to ensure proper dosage and modulation of UV power consumptions will be discussed.

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## The Predictability of Forest Recovery Using a Mechanistic Hydro-Ecological Model

*Kyongho Son, Ph.D., Hunter College, City University of New York; Elliot Schneiderman, NYC Department of Environmental Protection; Laurence Lin, Lawrence Band, Institute for the Environment, UNC-Chapel Hill*

Forests play a key role in regulating water quality in streams, and forest disturbances and harvesting can affect the water quality through major changes in hydrologic function and ecosystem. However, the prediction of forest recovery following forest disturbance through modeling is still difficult given the complex interactions among climate, hydrology and biogeochemistry. Additionally, the forest recovery data over large areas and long time periods are limited. This study tested the predictability of a mechanistic hydro-ecological model, Regional Hydro-Ecologic Simulation System (RHESSys) for capturing forest recovery after forest harvesting. The study site is the Frost Valley YMCA Model Forest, located in the Neversink River Basin that is also a part of New York City Water supply

watershed. Three areas within the site experienced different forest harvesting practices: light selective cut, heavy selective cut, and clear-cut. First, we used vegetation indices derived from Landsat imagery in order to develop the forest recovery data for three sites. Second, we calibrated the RHESSys model with measured streamflow, nitrate and dissolved organic carbon (DOC) fluxes. Third, the predictions of leaf area index using the calibrated model was compared with the estimated forestry recovery data. This study provides a framework to improve the model predictability of forest recovery after forest harvesting.

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## Improved Technology for Early Identification of Algal Blooms in the New York City Water Supply System

*Sara Storrer, Paul Brown, Ph.D., Chris Morgans, Karen Moore, Ph.D., NYC Department of Environmental Protection*

Water quality managers are seeking ways to improve the timing and frequency of sample collection for early identification of algal blooms in the New York City water supply system. Starting in May 2015 the NYCDEP deployed wireless vertical profiling buoy systems at the Cannonsville and Neversink Reservoirs. These buoys were deployed primarily to collect high-frequency data to gain a better understand of in-reservoir Dissolved Organic Carbon (DOC) loading to support reservoir eutrophication models. The profiling buoys suspend multiparameter sondes containing sensors which record temperature, dissolved oxygen, turbidity, specific conductivity, and fluorescence at three wavelengths to characterize chlorophyll, blue-green algae, and dissolved organic matter. Measurements were taken every meter in reservoir depth four times daily to capture daily, seasonal, and annual water quality conditions. Additionally, traditional fixed-frequency grab samples were also taken bimonthly along with corresponding sensor measurements. This intensive monitoring effort permits the rapid evaluation of changes in physical, chemical, and biological parameters, whereas many times the peak of an algal bloom is missed with traditional fixed-frequency sampling. Initial results from NYCDEP's wireless vertical profiling buoys suggest that the Chlorophyll/Blue-Green Algae (BGA) sensor may help in identifying algal blooms before they reach nuisance levels, and aid in guiding sampling strategies to better capture algal blooms. The statistical analysis of patterns in Chlorophyll/BGA sensor data and relationships to other field- and lab-measured analytes will be presented. The data collected by these sensors can be used to evaluate the potential for early detection of algal blooms and for optimizing the timing of

algal sampling, particularly for the collection of samples for cyanotoxin analysis.

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## **A Progress Report on NYC's Watershed Land Acquisition Program**

*Dave Tobias, NYC Department of Environmental Protection*

New York City's watershed is one of the largest managed surface water supply systems in the world. At over one million acres (2,000 square miles, or 5,180 square kilometers), the watershed is larger than about 30 of the world's ~200 sovereign nations, and supplies water to nine million consumers in the largest metropolitan area in the US, which is also one of the largest urban centers in the world. To deliver 1+ billion gallons of water daily to consumers, the City depends on a vast infrastructure of dams, tunnels and aqueducts - and to ensure long term water quality, the City seeks to permanently protect sensitive properties in a watershed where over 60 percent of land remains privately owned. In order to secure current and future water quality, the City has thus been developing programs that focus on permanent protection of key properties, generally focusing on those that (1) contain watercourses connected to the tributary system and reservoirs, (2) are endowed with development potential (which can be 'retired'), and (3) exhibit reasonable cost-benefit ratios. This presentation will provide a sweeping overview and status report on the City's land acquisition initiatives and stewardship programs, a description of how GIS tools facilitate the work, and a discussion of successes and obstacles encountered to date.

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## **Potential Water Quality Impacts of Wildfires to the New York City Water Supply**

*Richard Van Dreason, NYC Department of Environmental Protection*

Water quality impacts from wildfires have been well documented in the Western United States, especially in recent years. Although, currently not as prone to wildfires as the west, models predict a much higher occurrence in the North East portion of the United States in the coming decades. Recognizing this possibility, NYCDEP is

participating in a Water Research Foundation project that seeks to develop a laboratory test that will help quantify potential wildfire impacts to drinking water quality. The test attempts to simulate low, moderate, and high wildfire severities through the controlled burning of samples consisting of forest litter and soil collected from 5 locations in each of 4 NYC watersheds. The burned samples will then be leached with water and analyzed for a variety of analytes including turbidity and disinfection by products. Although results are not yet available, we will provide an introduction to the project as well as discuss examples of impacts that have been documented in the literature. We will also discuss a fire that occurred in 2014 along the shore of Kensico Reservoir, the terminal reservoir in the NYC supply.

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## **Preconstruction Monitoring Associated with the Conversion of Individual Septic Systems to Sewers**

*David Van Valkenburg, NYC Department of Environmental Protection*

In 2009 the NYCDEP began a monitoring program to evaluate the water quality benefits associated with the Environmental Infrastructure Program. As part of this assessment, two areas were selected for conversion of residential septic systems to a sewer system in 2016: one within the Schoharie Watershed and the other in the Pepacton Watershed. The monitoring focused upon constituents (nitrogen, phosphorus, DOC, coliform, pH, temperature, specific conductivity, chloride, and sulfate) regularly associated with elevated concentrations when septic system sources exist. The preconstruction results were evaluated to determine if there were quantifiable differences between the above and below project locations. Data analysis included temporal data plots, nonparametric statistics, and comparison of the frequency of analytes non-detections between the paired sites. Some of the analytes show a significant difference between sites above and below the proposed converted area that can allow for an evaluation of post-construction monitoring to determine the overall improvement of downstream water quality.

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